

We claim:

1. A microcellular communications system, comprising:  
a plurality of commonly located microcell base station units each connected by a fiber path to a plurality of corresponding antenna units, each base station unit including:  
RF transmitters and receivers, one for each channel assigned to the microcell;  
combiner means for combining the RF signal output from the transmitters;  
analog-to-digital means for converting the combined signal to a digitized stream of samples;  
framing means for framing the digitized stream;  
means for receiving the framed stream and for applying a corresponding laser signal to the fiber path for transmission to the corresponding antenna unit; and  
optical receiver means for detecting the serial bit stream optically modulated on the fiber;  
wherein each antenna unit further includes:  
demultiplexer means for receiving the framed stream and extracting the digitized RF signal;  
digital-to-analog means for receiving the digitized RF signal and reconstructing the analog RF signal;  
amplifier means for amplifying the reconstructed signal;  
antenna means for receiving the amplified signal and broadcasting it into a microcell area;  
means for receiving an RF microcell traffic signal received at the antenna;  
analog-to-digital converter for converting the received RF microcell traffic to a digitized data stream;  
framer means for framing the digitized stream; and  
laser means for receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding base station unit;  
wherein each base station unit further includes:  
demultiplexer means for receiving the framed microcell traffic stream from the antenna unit and extracting the digitized RF signal; and

digital-to-analog converter receiving the digitized RF signal and reconstructing the analog RF signal, the RF signal being applied to the receivers.

2. The system according to claim 1 further including means for multiplexing at least one additional channel with the microcell traffic carried on said fiber.

3. The system according to claim 2 wherein some of the additional channels are for the provision of alternate services.

4. The system according to claim 3 wherein one of the additional channels is a personal communications network (PCN) channel.

5. The system according to claim 3 wherein one of the additional channels is a paging service channel.

6. The system according to claim 2 wherein one of the additional channels is an alarm channel

7. The system according to claim 2 wherein one of the additional channels is a voice channel to carry two-way point-to-point voice grade communication between the base station and antenna unit.

8. A microcellular communications system for providing mobile telephone service to a microcell area over a cable system, comprising:

a microcell base station unit connected by a fiber path to a head end unit located in a head end station of a cable television distribution system having a plurality of optical nodes connected to the head end unit over respective fiber paths, the base station unit including:

a plurality of RF transmitters and receivers, one for each channel assigned to the microcell, the plurality of channels making up a cellular band;

combiner means for combining the RF signal output from the transmitters;

analog-to-digital converter means for converting the cellular band content of the combined signal to a digitized stream of samples;

first framing means for framing the digitized stream; and  
digitally modulated laser means for receiving the framed stream  
and applying a corresponding laser signal to the fiber path for  
transmission to the head end unit;  
the head end unit including:  
demultiplexer means for receiving the framed stream and extracting  
the digitized RF signal;  
digital-to-analog converter means for receiving the digitized RF  
signal and reconstructing an analog RF signal containing the cellular  
band;  
one or more filter means for separating the cellular band into a  
plurality of sub-bands, each sub-band containing a sub-set of said  
plurality of channels;  
modulator means for modulating one of said sub-bands and applying  
the modulated output to an optical transmitter producing a  
corresponding optical signal for application to one of said fiber paths  
connected to a optical node;  
optical receiver means for receiving a modulated optical signal  
carrying a sub-band and producing a corresponding electrical signal for  
application to a demodulator for demodulating the sub-band to produce a  
corresponding analog RF signal including the sub-band;  
analog-to-digital converter means for receiving the RF signal from  
the demodulator and converting the RF signal to a digitized data  
stream;  
second framing means for framing the digitized stream; and  
digitally modulated laser means for receiving the framed stream  
and applying a corresponding laser signal to the fiber path for  
transmission to the corresponding base station unit;  
wherein each base station unit further includes:  
demultiplexer means for receiving the framed microcell traffic  
stream from the antenna unit and extracting the digitized RF signal;  
digital-to-analog converter means for receiving the digitized RF  
signal and reconstructing the analog RF signal, the RF signal being  
applied to the receivers; and  
an optical node unit located at the optical node of the cable  
television system, the optical node unit including:  
optical receiver means for receiving the modulated sub-band on  
said one fiber path;

demodulator means for demodulating the modulated sub-band to produce an RF signal containing the sub-band;  
amplifier means for amplifying the RF signal for transmission from a main antenna;  
filter means for filtering out the sub-band from RF received at the main antenna;  
modulator means for modulating the received sub-band; and  
optical transmitter means for applying a corresponding optical signal to the one fiber path.

9. The system according to claim 8 wherein the modulator means and demodulator means in said head end unit and optical node unit are amplitude modulated (AM) so that the sub-band is carried over the one fiber path in analog format.

10. A microcellular communications system for providing mobile telephone service to a microcell area over a cable system and using digital modulation, comprising:

a microcell base station unit connected by a fiber path to a head end unit located in a head end station of a cable television distribution system having a plurality of optical nodes connected to the head end unit over respective fiber paths, the base station unit including:

a plurality of RF transmitters and receivers, one for each channel assigned to the microcell, the plurality of channels making up a cellular band;

combiner means for combining the RF signal output from a subset of the transmitters, said subset comprising a sub-band;

analog-to-digital converter means for converting the cellular band content of the combined signal to a digitized stream of samples;

framer means for framing the digitized stream; and

laser means for receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the head end unit;

the head end unit further including:

demultiplexer means for receiving the framed stream and extracting the digitized RF signal corresponding to said subset of transmitters;

digital modulator means for receiving the digitized RF sub-band signal and applying a modulated output to an optical transmitter producing a corresponding optical signal for application to one of said fiber paths connected to a optical node;

optical receiver means for receiving a modulated optical signal carrying a digitized RF signal corresponding to said sub-band and producing a corresponding electrical signal for application to a digital demodulator, the digital demodulator producing a digital data stream corresponding to the sub-band;

framing means for framing the digitized stream; and

laser means for receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the base station unit;

wherein each base station unit further includes:

demultiplexer means for receiving the framed microcell traffic stream from the antenna unit and extracting the digitized RF signal;

digital-to-analog converter means for receiving the digitized RF signal and reconstructing the analog RF signal, the RF signal being applied to the receivers; and

an optical node unit located at the optical node of the cable television system, the optical node unit including:

optical receiver means for receiving the modulated sub-band on said one fiber path;

digital demodulator means for demodulating the modulated sub-band to produce a digital signal containing the digitized sub-band;

digital-to-analog converter means for converting the digital signal to a corresponding RF signal;

amplifier means for amplifying the RF signal for transmission from a main antenna;

filter means for filtering out the sub-band from RF received at the main antenna;

analog-to-digital converter means for converting the analog RF signal to a corresponding digital signal;

digital modulator means for modulating the digital signal; and

optical transmitter means for applying a corresponding laser signal to the one fiber path.

11. A microcellular communications system utilizing the switched telephone network for transmission of the RF signal, comprising:  
a plurality of commonly located microcell base station units and a plurality of associated antenna unit, each base station units including:  
RF transmitters and receivers, one for each channel assigned to the microcell;  
combiner means for combining the RF signal output from a subset of the transmitters;  
analog-to-digital converter means for converting the combined signal to a digitized stream of samples;  
framer means for framing the digitized stream to a signal format compatible with the switched telephone network; and  
interface means for interfacing the framed signal with the switched telephone network and addressing it to a remote antenna unit;  
wherein each antenna unit includes:  
interface means for interfacing to the switched telephone network to receive the digitized stream;  
demultiplexer means for receiving the framed stream and extracting the digitized RF signal;  
digital-to-analog converter means for receiving the digitized RF signal and reconstructing the analog RF signal;  
power amplifier means for amplifying the reconstructed signal;  
antenna means for receiving the amplified signal and broadcasting it into a microcell area;  
analog-to-digital converter means for receiving an RF microcell traffic signal received at the antenna;  
analog-to-digital converter means for converting the received RF microcell traffic to a digitized data stream; and  
framer means for framing the digitized stream to a signal format compatible with the switched telephone network;  
the interface means further for receiving the digitized stream and transmitting it over the switched network to the corresponding base station unit;  
wherein each base station unit further includes:

demultiplexer means for receiving the framed microcell traffic stream from the antenna unit and extracting the digitized RF signal; and

digital-to-analog converter means for receiving the digitized RF signal and reconstructing the analog RF signal, the RF signal being applied to the receivers.

12. A microcellular communications system, comprising:

a plurality of commonly located microcell base station units each connected by a fiber path to a corresponding antenna unit, each base station unit including:

synthesizer means for receiving a phone signal from a mobile telecommunications switching office and converting it to a digitized stream of samples which when applied to a digital-to-analog converter in an antenna unit, provides a corresponding RF signal;

framer means for framing the digitized stream; and

digitally modulated laser means for receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding antenna unit; each antenna unit further including:

demultiplexer means for receiving the framed stream and extracting the digitized stream of samples;

digital-to-analog converter means for receiving the digitized RF signal and reconstructing the analog RF signal;

power amplifier means for amplifying the reconstructed signal;

antenna means for receiving the amplified signal and broadcasting it into a microcell area;

analog-to-digital converter means for receiving an RF microcell traffic signal received at the antenna;

analog-to-digital converter means for converting the received RF microcell traffic to a digitized data stream;

framer means for framing the digitized stream; and

digitally modulated laser means for receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding base station unit; wherein each base station unit further includes:

demultiplexer means for receiving the framed microcell traffic stream from the antenna unit and extracting the digitized RF signal;

the synthesizer means further including means for converting the extracted digitized RF signal to a form that can be transmitted to the MTSO.

13. A method of staged deployment of a digital microcellular communications system, comprising the steps of:

(a) deploying a plurality of commonly located analog microcell base station units, each connected by a fiber path to a corresponding remote antenna unit, each analog base station unit including: RF transmitters and receivers, one for each channel assigned to the microcell; a combiner to combine the RF signal output from the transmitters; a broadband analog-to-digital converter for converting the combined signal to a digitized stream of samples; a framing circuit for framing the digitized stream; a digitally modulated laser receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding antenna unit;

(b) deploying a plurality of remote antenna units, each antenna unit including: a demultiplexer for receiving the framed stream and extracting the digitized RF signal; a digital-to-analog converter receiving the digitized RF signal and reconstructing the analog RF signal; a power amplifier for amplifying the reconstructed signal; an antenna receiving the amplified signal and broadcasting it into a microcell area; an analog-to-digital converter for receiving an RF microcell traffic signal received at the antenna; an analog-to-digital converter for converting the received RF microcell traffic to a digitized data stream; a framing circuit for framing the digitized stream; a digitally modulated laser receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding base station unit;

the base station unit further including: a demultiplexer for receiving the framed microcell traffic stream from the antenna unit and extracting the digitized RF signal; a digital-to-analog converter receiving the digitized RF signal and reconstructing the analog RF signal, the RF signal being applied to the receivers; and

(c) replacing the plurality of analog microcell base stations with a plurality of all digital base stations, each of said all digital base stations comprising: a synthesizer means for receiving a phone signal from a mobile telecommunications switching office and converting it to a digitized stream of samples which when applied to a digital-to-analog converter in an antenna unit, provides a corresponding RF signal; a framing circuit for framing the digitized stream; a digitally modulated laser receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding antenna unit.

14. A microcellular communications system, comprising:

a plurality of commonly located microcell base station units each connected by a fiber path to a corresponding antenna unit, each base station unit including:

RF transmitters and receivers, one for each channel assigned to the microcell;

combiner means for combining the RF signal output from the transmitters;

analog-to-digital converter means for converting the combined signal to a digitized stream of samples;

framer means for framing the digitized stream; and

digitally modulated laser means for receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding antenna unit;

each antenna unit including:

demultiplexer means for receiving the framed stream and extracting the digitized RF signal;

digital-to-analog converter means for receiving the digitized RF signal and reconstructing the analog RF signal;

power amplifier means for amplifying the reconstructed signal;

primary antenna means for receiving the amplified signal and broadcasting it into a microcell area;

analog-to-digital converter means for receiving a primary RF microcell traffic signal received at the primary antenna;

analog-to-digital converter means for converting the received RF microcell traffic to a first digitized data stream;

diversity antenna means for receiving a diversity RF traffic signal;

analog-to-digital converter means for converting the received diversity RF traffic signal to a second digitized data stream;

framer means for framing the primary and diversity digitized data streams; and

digitally modulated laser means for receiving the framed stream and applying a corresponding laser signal to the fiber path for transmission to the corresponding base station unit;

wherein each base station unit further includes:

demultiplexer means for receiving the framed microcell traffic stream from the antenna unit and extracting the digitized RF signal;

digital-to-analog converter means for receiving the primary digitized RF signal and reconstructing the primary analog RF signal, the strongest of the diversity or primary RF signal being applied to the receivers; and

digital-to-analog converter means for receiving the diversity digitized RF signal and reconstructing the diversity analog RF signal.

15. A cellular communications system having a cell with a plurality of assigned channels, comprising:

a cell base station unit connected by transmission means to a corresponding antenna unit having an antenna located for broadcast and reception of signals in an area associated with the cell, the base station unit including:

a plurality of RF transmitters and receivers, one for each channel assigned to the cell;

combiner means for combining the RF signal output from the transmitters;

analog-to-digital conversion means for converting the combined signal to a digitized stream of samples;

framing means for framing the digitized stream; means for receiving the framed stream and for applying a corresponding digital signal to the transmission means for transmission to the corresponding antenna unit; and

receiver means for receiving a digital bit stream from the transmission means from the corresponding antenna unit; wherein each antenna unit further includes:

demultiplexer means for receiving the framed stream and extracting the digitized RF signal;

digital-to-analog means for receiving the digitized RF signal and reconstructing the analog RF signal;

amplifier means for amplifying the reconstructed signal;

means for applying the amplified signal to the antenna so that it is broadcast into an area associated with the cell;

means for receiving an RF signal received at the antenna;

analog-to-digital converter for converting the received RF signal to a digitized data stream;

framer means for framing the digitized stream; and

means for receiving the framed stream and applying it to the transmission means for transmission to the base station unit; wherein each base station unit further includes:

demultiplexer means for receiving the framed signal from the antenna unit and extracting the digitized RF signal; and

digital-to-analog converter receiving the digitized RF signal and reconstructing the analog RF signal, and means for applying the RF signal to the receivers.

16. A cellular communications system including a cell, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units using RF transmission, comprising:

a cell base station unit connected by transmission means to a corresponding antenna unit having an antenna located for broadcast and reception of signals in an area associated with the cell, the base station unit including:

analog RF signal generation means for generating a plurality of RF signals on different channels carrying telephone signals to mobile units in the cell area, and for combining the RF signals to form a composite analog signal;

analog-to-digital conversion means for converting the composite signal to a digitized stream of samples and applying the

~~samples to the transmission means for transmission to the corresponding antenna unit;~~

~~wherein each antenna unit further includes:~~

~~digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing the corresponding composite analog RF signal, and applying the amplified signal to the antenna so that it is broadcast into the area associate with the cell;~~

~~analog-to-digital means for receiving an RF signal received at the antenna, converting the received RF signal to a digitized stream of samples and applying the samples to the transmission means for transmission to the base station unit; and wherein each base station unit further includes:~~

~~digital-to-analog converter means for receiving the digitized stream of samples from the antenna unit, and reconstructing the analog RF signal.~~

17. A cellular communications system including a cell, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units using RF transmission, comprising:

a cell base station unit connected by transmission means to a corresponding antenna unit having an antenna located for broadcast and reception of signals in an area associated with the microcell, the base station unit including:

~~means for receiving an analog telephone signal from a radio controller and for digitally synthesizing the generation of a plurality of RF signals on different channels for carrying the telephone signals to mobile units in the microcell area, and for generating a digitized stream of samples corresponding to a digitized form of the plurality of synthesized RF signals, and applying the samples to the transmission means for transmission to the corresponding antenna unit;~~

~~wherein each antenna unit further includes:~~

~~digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing the corresponding composite analog RF signal, and applying the~~

amplified signal to the antenna so that it is broadcast into the area associate with the cell;

analog-to-digital means for receiving an RF signal received at the antenna, converting the received RF signal to a digitized stream of samples and applying the samples to the transmission means for transmission to the base station unit; and wherein each base station unit further includes:

converter means for receiving the digitized stream of samples from the antenna unit, digitally synthesizing a digital form of analog telephone signals represented in the samples, and generating corresponding telephone signals, and supplying them to the telephone radio controller.

18. A cellular communications system including a cell, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units using RF transmission, comprising:

a cell base station unit connected by transmission means to a corresponding antenna unit having an antenna located for broadcast and reception of signals in an area associated with the cell, the base station unit including:

means for receiving a plurality of telephone signals in digital form from an interface to a mobile telephone switching office and for digitally synthesizing the generation of a plurality of RF signals on different channels for carrying the telephone signals to mobile units in the cell area, and for generating a digitized stream of samples corresponding to a digitized form of the plurality of synthesized RF signals, and applying the samples to the transmission means for transmission to the corresponding antenna unit;

wherein each antenna unit further includes:

digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing the corresponding composite analog RF signal, and applying the amplified signal to the antenna so that it is broadcast into the area associate with the cell;

analog-to-digital means for receiving an RF signal received at the antenna, converting the received RF signal to a digitized

stream of samples and applying the samples to the transmission means for transmission to the base station unit; and wherein each base station unit further includes:

digital-to-analog converter means for receiving the digitized stream of samples from the antenna unit, digitally synthesizing the analog telephone signals represented in the samples, and applying the digital telephone signals to an interface to the mobile telephone switching office.

19. A cellular communications system including a cell, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units in the cell using RF transmission, comprising:

a cell base station unit connected by transmission means to a plurality of antenna units each having an antenna located for broadcast and reception of signals in a zone associated with the antenna unit, the zones all located in the cell, the base station unit including:

digitizing means for receiving a plurality of telephone signals from a mobile telephone switching office and for digitally synthesizing the generation of a plurality of RF signals on different channels for carrying the telephone signals to mobile units in the cell, and for generating a plurality of digitized streams of samples corresponding to the synthesized RF signals, one of said digitized streams being generated for each antenna unit, said digitizing means including means responsive to a first control signal for controlling each channel in each stream of samples so that the channels represented in each stream can be controlled, and applying the samples of each stream to the transmission means for transmission to the corresponding antenna units;

wherein each antenna unit further includes:

digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing a corresponding analog RF signal, and the signal to the antenna so that it is broadcast into the area associate with the cell;

analog-to-digital means for receiving an RF signal received at the antenna, converting the received RF signal to a digitized stream of samples and applying the samples to the transmission means for transmission to the base station unit; and

wherein each base station unit further includes:

converter means for receiving the respective digitized streams of samples from the antenna units, digitally synthesizing the analog telephone signals represented in the samples, and generating corresponding telephone signals for delivery to the mobile telephone switching office, said converter means including means responsive to a second control signal to select at least one of said channels from one of said streams of samples from the antenna units and using the at least one channels to synthesize the digital form of the analog telephone signal carried on that channel, so that the zone from which a channel is obtained can be selected; and

controller means for monitoring the digitized samples received from each antenna unit, digitally analyzing the energy level of each channel in each stream, and generating said first and second control signals to said digitizing means and said converter means so that the channels broadcast in each zone and the channels in each zone obtained to generate the received telephone signals can be controlled according to the energy level of signals received at the antenna units.

20. A system according to claim 19 further wherein said control means includes fade control means for monitoring the fading of an RF signal received in a zone and for generating the second control signal to switch the zone from which the RF signal is obtained, whereby a diversity function is obtained.

21. A system according to claim 20 further wherein said fade control means can achieve said monitoring and switching within 1 second.

22. A cellular communications system including a cell divided into a plurality of zones, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units in the zones using RF transmission, comprising:

a cell base station unit connected by transmission means to a plurality of antenna units, at least one located in each zone, and each having an antenna located for broadcast and reception of signals in the associated zone, the base station unit including:

analog RF signal generation means for generating a plurality of RF signals on different channels for carrying telephone signals to mobile units in the cell;

first switch means responsive to a first control signal for switching and combining the RF signals to form a composite RF signal for each zone, the composite signal for each zone containing selected channels;

analog-to-digital conversion means for converting the composite signal for each zone to a corresponding digitized stream of samples and applying the samples to the transmission means for transmission to each corresponding antenna unit;

wherein each antenna unit further includes:

digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing a corresponding composite analog RF signal, and applying the amplified signal to the antenna so that it is broadcast into the area associate with the cell;

analog-to-digital means for receiving an RF signal received at the antenna, converting the received RF signal to a digitized stream of samples and applying the samples to the transmission means for transmission to the base station unit;

wherein each base station unit further includes:

digital-to-analog converter means for receiving the digitized streams of samples from each antenna unit, and reconstructing an analog RF signal for each antenna unit;

second switching and combining means responsive to a second control signal for selectively combining the RF signals from the antenna units to form a plurality of composite signals for application to the receivers, each of the composite signals comprising one or more of the RF signals from the antenna units; and

control means for monitoring the digitized streams of samples from all of the antenna units and digitally analyzing the energy level of each channel in each zone, and in response thereto generating the first and second control signals to selectively control the zones in which each channel is broadcast and the zone from which each channel is received.

23. A system according to claim 22 further wherein said control means includes fade control means for monitoring the fading of an RF

signal received in a zone and for generating the second control signal to switch the zone from which the RF signal is obtained, whereby a diversity function is obtained.

24. A system according to claim 23 further wherein said fade control means can achieve said monitoring and switching within 1 second.

25. A cellular communications system including a cell, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units using RF transmission, comprising:

a cell base station unit connected by transmission means to a corresponding antenna unit having an antenna located for broadcast and reception of signals in an area associated with the cell, the base station unit including:

analog RF signal generation means for generating a plurality of RF signals on different channels carrying telephone signals to mobile units in the cell area, and for combining the RF signals to form a composite analog signal; analog-to-digital conversion means for converting the composite signal to a digitized stream of samples;

digital filter means for filtering the composite signal and generating a plurality of individual digitized streams each corresponding to at least one of the channels, and for applying the individual data streams of samples to the transmission means for transmission to the corresponding antenna unit;

wherein each antenna unit further includes:

digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing a corresponding analog RF signal, and applying the amplified signal to the antenna so that it is broadcast into the area associate with the cell;

analog-to-digital means for receiving an RF signal received at the antenna and converting the received RF signal to a digitized stream of samples;

digital filter means for filtering the stream of samples derived from the received RF and generating a plurality of individual digitized streams of samples each corresponding to at least one of the

channels, and for applying the individual data streams to the transmission means for transmission to the base station unit; and wherein each base station unit further includes:

digital-to-analog converter means for receiving the digitized streams of samples from the antenna unit, reconstructing analog RF signals corresponding to each stream, and applying the RF signals to the receivers.

26. A system according to claim 25 further wherein the transmission means comprises the switched telephone network.

27. A cellular communications system including a cell, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units using RF transmission, comprising:

a cell base station unit connected by transmission means to a corresponding antenna unit having an antenna located for broadcast and reception of signals in an area associated with the cell, the base station unit including:

means for receiving an analog telephone signal from a radio controller and for digitally synthesizing the generation of a plurality of RF signals on different channels for carrying the telephone signals to mobile units in the cell area, and for generating a plurality of digitized streams of samples each corresponding to at least one digitized form of one of the synthesized RF signals, and applying the streams of samples to the transmission means for transmission to the corresponding antenna unit;

wherein each antenna unit further includes:

digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing a corresponding analog RF signal, and applying the amplified signal to the antenna so that it is broadcast into the area associate with the cell;

analog-to-digital means for receiving an RF signal received at the antenna, converting the received RF signal to a plurality of individual digitized streams of samples each corresponding to at least one channel, and applying the streams of samples to the transmission means for transmission to the base station unit; and

wherein each base station unit further includes:

digital-to-analog converter means for receiving the digitized streams of samples from the antenna unit, digitally synthesizing the telephone signals represented in the samples, reconstructing the analog telephone signals, and applying the telephone signals to the radio controller.

28. A system according to claim 27 further wherein the transmission means comprises the switched telephone network.

29. A cellular communications system including a cell, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units in the cell using RF transmission, comprising:

a cell base station unit connected by transmission means to a plurality of antenna units each having an antenna located for broadcast and reception of signals in a zone associated with the antenna unit, the zones all located in the cell, the base station unit including:

digitizing means for receiving a plurality of telephone signals from a mobile telephone switching office and for digitally synthesizing the generation of a plurality of RF signals on different channels for carrying the telephone signals to mobile units in the cell, and for generating a plurality of individual digitized streams of samples corresponding to the plurality of synthesized RF signals, one of said digitized streams being generated for each channel to be transmitted to antenna unit so that substantially only those channels to be transmitted in the zone are represented by the digitized streams of samples, said digitizing means including means responsive to a first control signal for controlling each channel so that the content of each channel transmitted to each antenna unit can be controlled, and applying the samples of each individual stream to the transmission means for transmission to the corresponding antenna units;

wherein each antenna unit further includes:

digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing the corresponding analog RF signals, and applying the RF signals to the antenna so that they are broadcast into the area associate with the cell;

analog-to-digital means for receiving an RF signal received at the antenna, generating a plurality of individual digitized streams

of samples each one corresponding to a digitized form of at least one of the channels in the received RF signal so that substantially only those channels received in the zone are represented by the digitized streams of samples, and applying the samples to the transmission means for transmission to the base station unit; and

wherein each base station unit further includes:

converter means for receiving the respective digitized streams of samples from the antenna units, digitally synthesizing a digital form of the analog telephone signals represented in the samples, and generating corresponding telephone signals for delivery to the mobile telephone switching office, said converter means including means responsive to a second control signal to select at least one of said channels from one of said streams of samples from the antenna units and using the at least one channel to synthesize the digital form of the analog telephone signal carried on that channel, so that the zone from which a channel is used can be selected; and

controller means for monitoring the digitized samples received from each antenna unit, digitally analyzing the energy level of each channel in each stream, and generating said first and second control signals to said digitizing means and said converter means so that the channels broadcast in each zone and the channels in each zone used to generate the received telephone signals can be controlled according to the energy level of signals received at the antenna units.

30. A system according to claim 29 further wherein said transmission means is a switched telephone network.

31. A system according to claim 30 further wherein said control means includes fade control means for monitoring the fading of an RF signal received in a zone and for generating the second control signal to switch the zone from which the RF signal is obtained, whereby a diversity function is obtained.

32. A system according to claim 31 further wherein said fade control means can achieve said monitoring and switching within 1 second.

33. A cellular communications system including a cell divided into a plurality of zones, wherein a plurality of telephone signals are transmitted and received between a base station and a corresponding plurality of mobile units in the zones using RF transmission, comprising:

a cell base station unit connected by transmission means to a plurality of antenna units, at least one located in each zone, and each having an antenna located for broadcast and reception of signals in the associated zone, the base station unit including:

analog RF signal generation means for generating a plurality of RF signals on different channels for carrying telephone signals to mobile units in the cell;

first switch means responsive to a first control signal for switching and combining the RF signals to form a composite RF signal for each zone, the composite signal for each zone containing selected channels;

analog-to-digital conversion means for converting the composite signal for each zone to a corresponding digitized stream of samples;

digital filter means for filtering the composite signal and generating a plurality of individual digitized streams each corresponding to at least one of the channels, and for applying the individual data streams of samples to the transmission means for transmission to the corresponding antenna unit;

wherein each antenna unit further includes:

digital-to-analog means for receiving the digitized stream of samples from the base station unit, reconstructing the corresponding composite analog RF signal, and applying the amplified signal to the antenna so that it is broadcast into the area associate with the microcell;

analog-to-digital means for receiving an RF signal received at the antenna, and converting the received RF signal to a digitized stream of samples;

digital filter means for filtering the stream of samples derived from the received RF and generating a plurality of individual digitized streams of samples each corresponding to at least one of the channels, and for applying the individual data streams to the transmission means for transmission to the base station unit;

wherein each base station unit further includes:

digital-to-analog converter means for receiving the digitized streams of samples from each antenna unit, and reconstructing an analog RF signal for each antenna unit;

second switching and combining means responsive to a second control signal for selectively combining the RF signals from the antenna units to form a plurality of composite signals for application to the receivers, each of the composite signals comprising one or more of the RF signals from the antenna units; and

control means for monitoring the digitized streams of samples from all of the antenna units and digitally analyzing the energy level of each channel in each zone, and in response thereto generating the first and second control signals to selectively control the zones in which each channel is broadcast and the zone from which each channel is received.

34. A system according to claim 33 further wherein said control means includes fade control means for monitoring the fading of an RF signal received in a zone and for generating the second control signal to switch the zone from which the RF signal is obtained, whereby a diversity function is obtained.

35. A system according to claim 34 further wherein said fade control means can achieve said monitoring and switching within 1 second.

36. A method of passive switching in a cellular phone system having a cell divided into a plurality of zones each sharing a common set of channels, comprising the steps of:

(a) at a base station, generating for each zone a digitized representation of the RF signal for the set of channels so that the channels broadcast from each zone can be individually controlled, and transmitting the digitized representations to each zone;

(b) receiving the digitized representations in each zone and generating a corresponding RF signal by digital-to-analog conversion, and broadcasting the RF signal in the zone;

- (c) receiving RF signals in the zone for the set of channels, and converting the RF signals to a corresponding digitized representation for transmission back to the base station;
- (d) at the base receiving the digitized representations from the zones and obtaining a corresponding RF signal for each zone; and
- (e) monitoring the digitized representation of the RF signals from each zone and based on the energy level of each channel in each zone
  - (i) selectively controlling the channels broadcast into the zones by controlling the generation of the digitized representations as performed in step (a) and (ii) selectively choosing which zone to obtain a received channel from so that passive switching may be accomplished.

37. A method of passive switching in a cellular phone system having a cell divided into a plurality of zones each sharing a common set of channels, comprising the steps of:

- (a) at a base station, generating for each zone a digitized representation of the RF signal for the set of channels so that the channels broadcast from each zone can be individually controlled, and transmitting a digitized representation for only those channels in the set to each zone;
- (b) receiving the digitized representations in each zone and generating a corresponding RF signal by digital-to-analog conversion, and broadcasting the RF signal in the zone;
- (c) receiving RF signals in the zone for the set of channels, and converting the RF signals to a corresponding digitized representation for transmission back to the base station, only those channels in the channel set being transmitted back to the base station;
- (d) at the base receiving the digitized representations from the zones and obtaining a corresponding RF signal for each zone;
- (e) monitoring the digitized representation of the RF signals from each zone and based on the energy level of each channel in each zone
  - (i) selectively controlling the channels broadcast into the zones by controlling the generation of the digitized representations as performed in step (a) and (ii) selectively choosing which zone to obtain a received channel from so that passive switching may be accomplished.

38. A method according to claim 37 further including the step of transmitting the digitized representations between the zones and the base station over a switched telephone network.

39. A method of transmitting cellular phone transmissions to a cell using set of channels, comprising the steps of:

(a) at a base station, generating a digitized representation of the RF signals for each channel and transmitting the representation to a cell remote from the base station;

(b) receiving the digitized representations at the cell and generating a corresponding RF signal by digital-to-analog conversion, and broadcasting the RF signal in the cell;

(c) receiving RF signals in the cell for the set of channels, and converting the RF signals to a corresponding digitized representation for transmission back to the base station; and

(d) at the base receiving the digitized representations from the cell and obtaining a corresponding RF signal for each channel.

40. A method of transmitting cellular phone transmissions to a cell using set of channels, comprising the steps of:

(a) at a base station, generating a digitized representation of the RF signals for each channel and transmitting substantially only the representations for each channel in the set to a cell remote from the base station, whereby the bandwidth required for transmission of the channels is limited over that required to transmit all channels in a cellular band;

(b) receiving the digitized representations at the cell and generating a corresponding RF signal by digital-to-analog conversion, and broadcasting the RF signal in the cell;

(c) receiving RF signals in the cell for the set of channels, and converting the RF signals to a corresponding digitized representation and transmitting substantially only the representations for each channel in the set to the base station, whereby the bandwidth required for transmission of the channels is limited over that required to transmit all channels in a cellular band; and

(d) at the base receiving the digitized representations from the cell and obtaining a corresponding RF signal for each channel.

~~41.~~ A method according to claim 40 further including the step of transmitting the digitized representations between the cell and the base station over the switched telephone network.

~~42.~~ A method of transmitting cellular phone transmissions to a cell using set of channels, comprising the steps of:

(a) at a base station, digitally synthesizing from a telephone signal received from a mobile telephone switching office a digitized representation of the RF signals for each channel and transmitting the representation to a cell remote from the base station so that no analog transmitters are required;

(b) receiving the digitized representations at the cell and generating a corresponding RF signal by digital-to-analog conversion, and broadcasting the RF signal in the cell;

(c) receiving RF signals in the cell for the set of channels, and converting the RF signals to a corresponding digitized representation for transmission back to the base station; and

(d) at the base receiving the digitized representations from the cell and digitally obtaining a corresponding telephone signal for each channel so that no analog receivers are required.

~~43.~~ A method of transmitting cellular phone transmissions to a cell using set of channels, comprising the steps of:

(a) at a base station, digitally synthesizing from a telephone signal received from a mobile telephone switching office a digitized representation of the RF signals for each channel and transmitting substantially only the representations for each channel in the set to a cell remote from the base station, so that analog transmitters are not required and whereby the bandwidth required for transmission of the channels is limited over that required to transmit all channels in a cellular band;

(b) receiving the digitized representations at the cell and generating a corresponding RF signal by digital-to-analog conversion, and broadcasting the RF signal in the cell;

(c) receiving RF signals in the cell for the set of channels, and converting the RF signals to a corresponding digitized representation and transmitting substantially only the representations for each channel in the set to the base station, whereby the bandwidth required

~~for transmission of the channels is limited over that required to transmit all channels in a cellular band; and~~

~~(d) at the base receiving the digitized representations from the cell and digitally obtaining a corresponding telephone signal for each channel so that analog receivers are not required.~~

44. A method according to claim 43 ~~further including the step of transmitting the digitized representations between the cell and the base station over the switched telephone network.~~

45. ~~A method of passive switching in a cellular phone system having a plurality of macrocells including a first macrocell, each macrocell sharing a common set of channels, comprising the steps of:~~

~~(a) providing a plurality of primary and secondary microcell antenna units;~~  
~~(b) dividing the first macrocell into a plurality of primary microcells, wherein the step of dividing includes placing the primary microcell antenna units so as to provide coverage over the first macrocell;~~

~~(c) providing a plurality of secondary microcell antenna units;~~  
~~(d) placing the secondary microcell antenna units to provide macrocell coverage overlapping the primary microcells;~~

~~(e) at a base station, generating a digitized representation of a telephone signal received from a mobile telephone switching office, selecting a microcell from said plurality of primary and secondary microcells and transmitting the digitized representation to the microcell antenna unit of the selected microcell;~~

~~(f) receiving, at the selected microcell, the digitized representation, generating a corresponding RF signal by digital-to-analog conversion, and broadcasting the RF signal in the selected microcell;~~

~~(g) receiving RF signals in each of the plurality of primary and secondary microcells for the set of channels, and converting the RF signals received to corresponding digitized RF signal representations for transmission back to the base station;~~

~~(h) at the base receiving the digitized RF signal representations from the primary and secondary microcells; and~~

(i) monitoring the digitized RF signal representations from each of the primary and secondary microcells and based on the energy level of each channel in each zone;

selectively controlling the channels broadcast into each of the primary and secondary microcells by controlling the generation of the digitized representations as performed in step (e); and

selectively choosing the microcell from the plurality of primary and secondary microcell in which a received channel is received so that passive switching may be accomplished.

46. The method according to claim 45 wherein the step of generating a digitized representation of a telephone signal received from a mobile telephone switching office comprises digitally synthesizing a digitized representation of RF signals to be transmitted for each channel from the telephone signal received from the mobile telephone switching office.

47. The method according to claim 45 wherein the step of generating a digitized representation of a telephone signal received from a mobile telephone switching office comprises generating a digitized representation of RF signals generated for each channel.

48. A method of sectorizing coverage over a particular cellular communications area, comprising the steps of:

providing a remote unit having a plurality of microcell antenna units, including a first and a second microcell antenna unit, wherein each microcell antenna unit comprises an antenna configured to cover a particular sector and a channel filter unit used to filter channels assigned to the particular sector;

connecting the remote unit to a sectorized base station unit, wherein the step of connecting comprises providing a unique sector frequency associated with each antenna unit sector;

connecting the sectorized base station unit to a mobile telecommunications switching office;

generating, at the sectorized base station unit, a digitized representation of a telephone signal received from the mobile telephone switching office;

~~transmitting the digitized representation to the microcell antenna unit for a particular sector;~~

~~receiving, at the first microcell antenna unit, a first RF signal, digitizing the first RF signal and converting the digitized first RF signal to a first sector frequency;~~

~~receiving, at the second microcell antenna unit, a second RF signal, digitizing the second RF signal and converting the digitized second RF signal to a second sector frequency; and~~

~~multiplexing the digitized first RF signal at the first sector frequency and the digitized second RF signal at the second sector frequency and transmitting the multiplexed signal to the sectorized base station.~~

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